Exit Presentation

Kate Melone

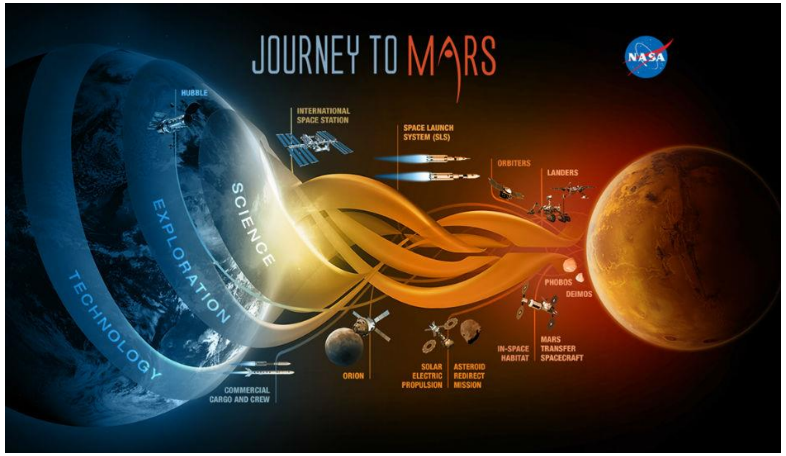
12/8/16

Overview

- About Me
  - Education
  - Hobbies and Interests
  - Past Experiences
- Projects
  - Radiated Materials Tensile Testing
  - Outgassing Testing for SHERLOC on Mars 2020 Rover
  - Z2 Support
  - LCVG Flush and Purge Console
- Lessons Learned
- Future Plans
- Acknowledgements

About Me

- Born and raised in Delaware
- I have a cat named Comet
- Dream car: Lamborghini
- Favorite TV Show: Leave It To Beaver
- Space Geek
  - Manned Space Exploration
  - Crew Systems, Orbital Mechanics, Aerodynamics, Propulsion



Education

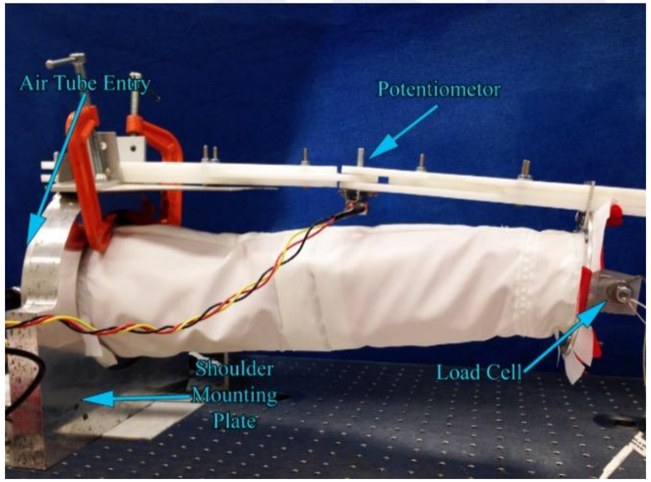
- University of Maryland, College Park
  - Go Terps!
- Pursuing my B.S. in Aerospace Engineering
  - Concentration in Astronautics

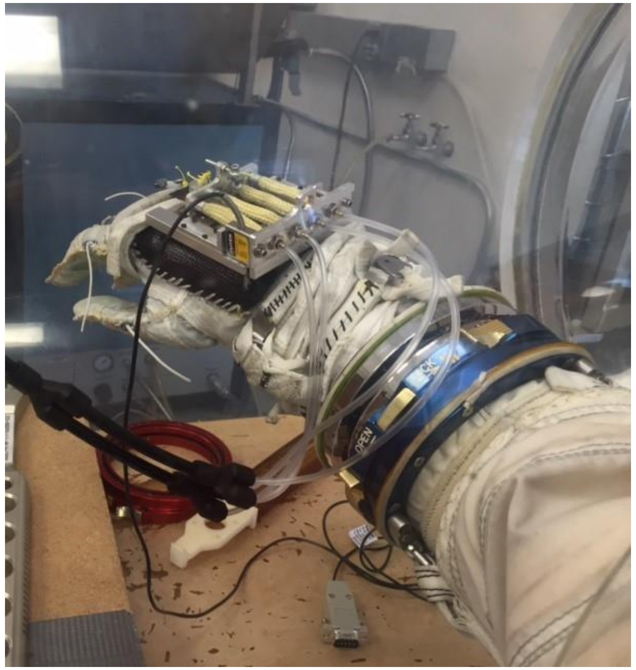
Hobbies and Interests

- Sports
  - Basketball, football, hockey, baseball, soccer
- Music
  - Listening to music and going to concerts
- Family and Friends
  - Spending time with family and friends

Past Experiences: UMD Research and Conferences

- Undergraduate research
  - Analog space suit joint torque elbow testing
  - Development of analog spacesuits
  - Pneumatically powered EVA Glove
- Conferences and Papers
  - AIAA Region 1 Student Paper Conference (Spring 2014, planning to go Spring 2017)
  - AIAA Young Professionals, Students, and Education Conference (Fall 2014 and Fall 2015)

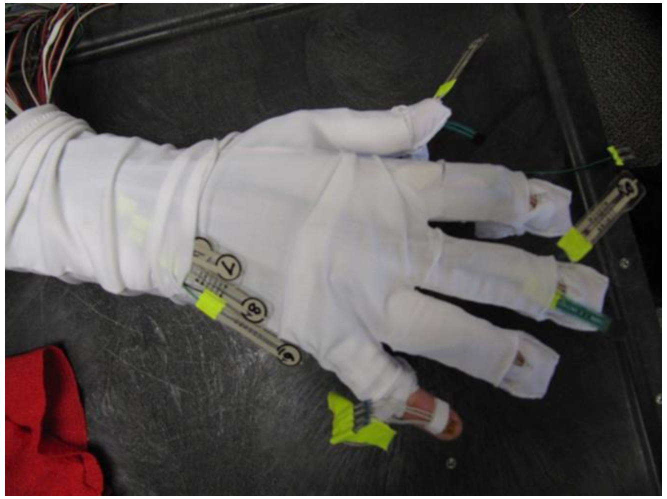


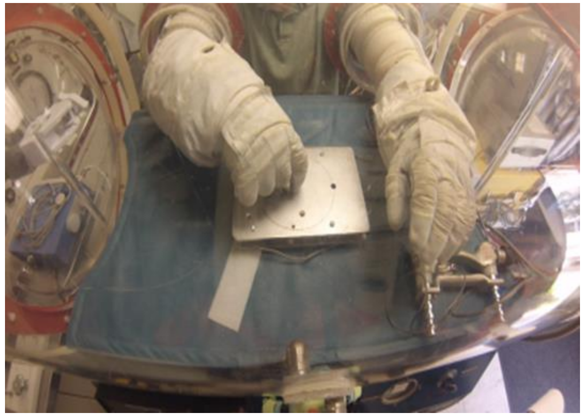


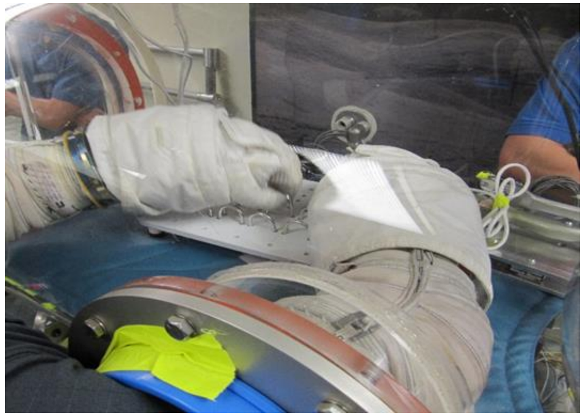
Past Experiences: JSC SK3 Summer 2014 Internship

EVA Glove Sensor Feasibility II Project

- **Goals:** Develop a method and list of sensors for measuring the glove environment acting on the fingers and hands inside the glove box
- **Importance:** Obtain data that can be correlated with astronaut injury reports
- **Accomplishments:** Analyzed extensive amounts of data and assisted in writing the EVA Glove Sensor Feasibility II Report



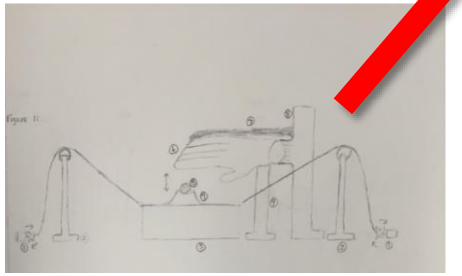


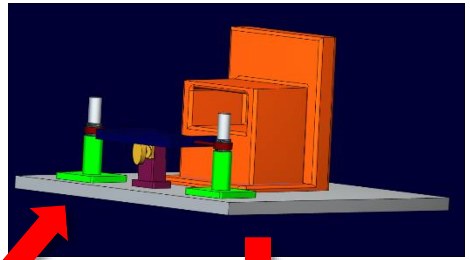


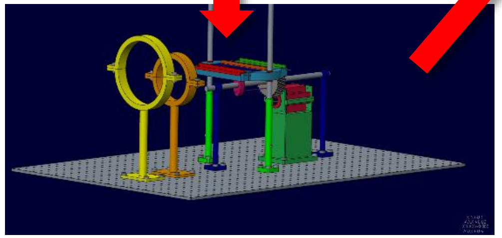
Past Experiences: JSC EC5 Summer 2015 Internship

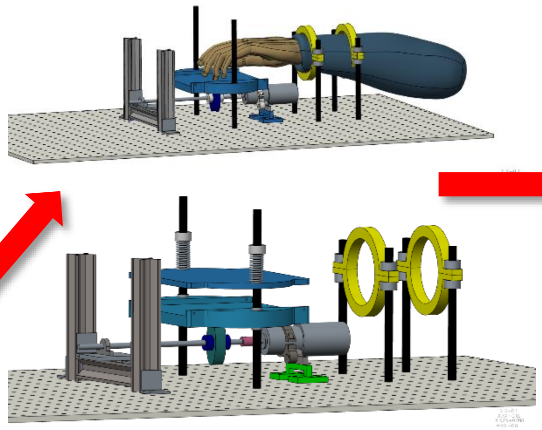
RoboGlove Cycle Tester

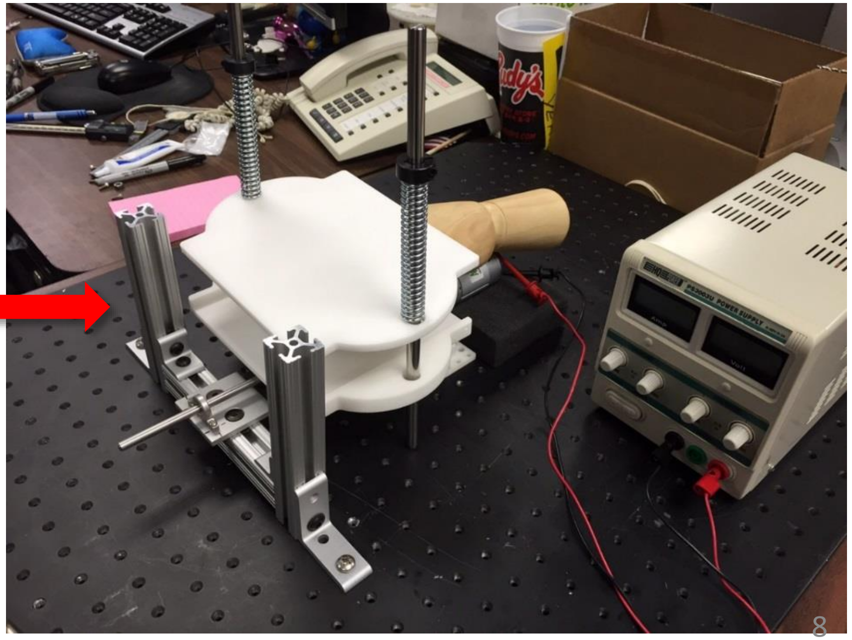
- **Goals:** Test repeatability and endurance of Force Sensitive Resistors (FSRs)
- **Importance:** Determine whether or not FSRs will suffice for long term use
- **Accomplishments:** Successfully designed and built a cycle tester by the completion of my internship











Tensile Testing of Radiated Space Suit Materials

Outgassing Testing for SHERLOC on Mars 2020 Rover

Z2 Support

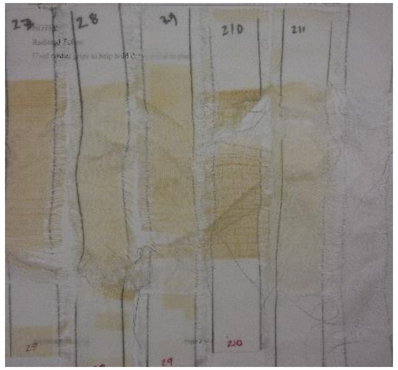
LCVG Flush and Purge Console

Tensile Testing of Radiated Materials

- Objective: Tensile test radiated space suit materials
- Purpose: Compare pre/post radiation mass, max tensile load, and max tensile extension

Radiated Materials Tensile Testing

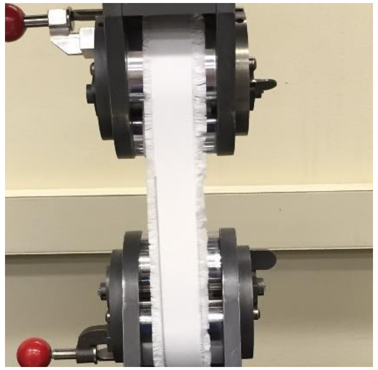
Orthofabric



Teflon

Vectran

Dacron

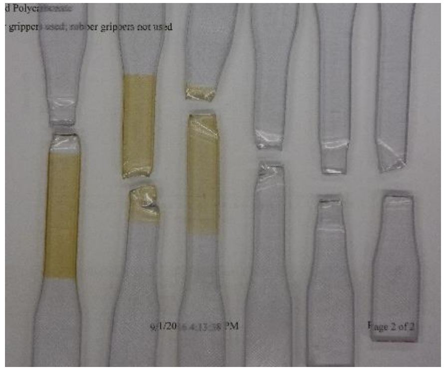


Spectra

Bladder Material

nGimat Coated Orthofabric

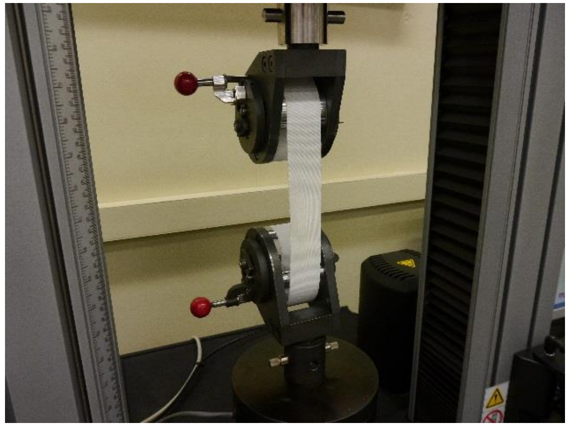
nGimat Coated Teflon

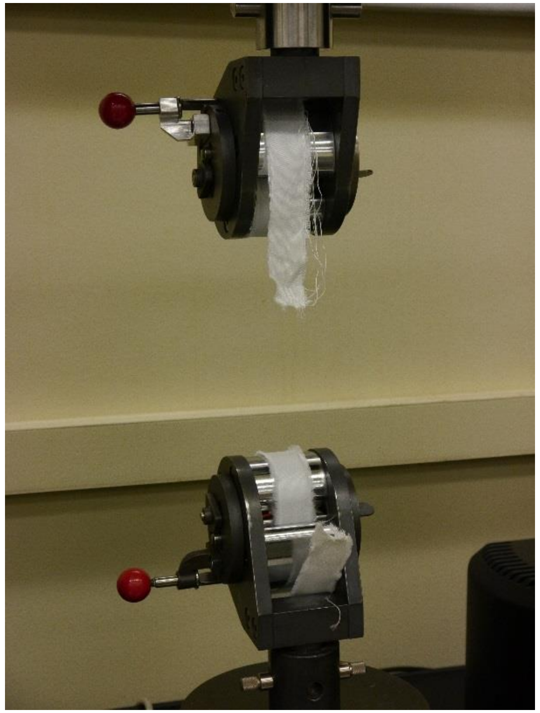


Polycarbonate

Radiated Materials Tensile Testing

- Conducted tensile testing of various radiated materials
  - Prepared samples for testing
  - Set up tests
  - Collected data





Radiated Materials Tensile Testing

- Assembled Test Reports
- Analyzed data and put together a test results summary of total mass loss (TML), fabric appearance, maximum/minimum max load, maximum/minimum max tensile extension

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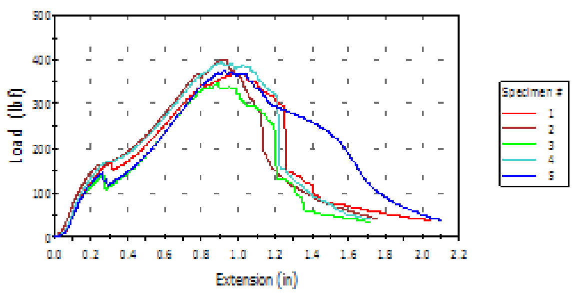
CTSD ADVANCED MATERIALS LABORATORY
BUILDING 7, ROOM 2023

Work Request	AML-16-19, Space Suit Material Testing
TPS	None
Part Number	TBD
Lot Number	TBD
2000 lbf. Load Cell (M209421)	Calibration Due Date: 7/15/2017
Test Speed (in./min.)	12
Temperature (deg F):	71.5
Humidity (%):	60
Operator	Joseph Settles and Kate Malone
Requestor	Kristine Larson (x34846)

AML-16-18, Ortho Cloth Test



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	Specimen label	Maximum Load (lbf)	Maximum Tensile Extension (in)	Comment
1	OnGO-77	367.47	0.97	
2	OnGO-78	401.01	0.91	
3	OnGO-79	347.61	0.89	
4	OnGO-710	394.30	0.91	
5	OnGO-712	373.67	0.92	

NOTES:

Radiated nGimat Orthofabric

Used rubber grips to help hold material in place

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Radiated Materials Tensile Testing

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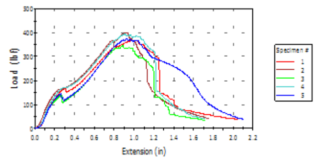

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	Specimen label	Maximum Load (lbf)	Maximum Tensile Extension (in)	Comment
1	OnGO-77	367.47	0.97	
2	OnGO-78	401.01	0.91	
3	OnGO-79	347.61	0.89	
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NOTES:

Radiated nGimat Orthofabric

Used rubber grips to help hold material in place

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Mass Difference (Absolute Value)

	Mass Change (g)		Mass Change (g)		Mass Change (g)		Mass Change (g)		Mass Change (g)
17	0.0083	27	0.0031	37	0.0055	47	0.0009	57	0.0238
18	0.0034	28	0.0042	38	0.005	48	0.001	58	0.0253
19	0.005	29	0.0092	39	0.0059	49	0.0014	59	0.0215
110	0.0036	210	0.0079	310	0.0083	410	0.001	510	0.0225
111	0.0049	211	0.0062	311	0.0068	411	0.0015	511	0.0192
112	0.0064	212	0.0014	312	0.0014	412	0.0002	512	[illegible]

Mass Change (Absolute Value)

	Mass (g)		Mass (g)		Mass (g)		Mass (g)
67	0.0027	77	0.0076	87	0	97	0.0047
68	0.0043	78	0.0066	88	0.0005	98	0.002
69	0.0038	79	0.0067	89	0.0007	99	0.0042
610	0.0035	710	0.0062	810	0.0008	910	0.0035
611	0.0035	711	0.0059	811	0.0002	911	0.0028
612	0.0015	712	0.0035	812	0.0011	912	0.0034

Tensile Testing Results Takeaways

Note: For Key Values section, range excludes the control value if the value does not lie within the min/max value; in other words, if the control value is a min or max value for the range, it is not included as the limit, rather the next min/max of the radiated sample is the new min/max range

Orthofabric

Assumed Control Sample: O-110

Key Values:

- Max Load Range (Excluding Control): 335.03 lbf-361.52 lbf
- Max Tensile Extension Range (Excluding Control): .22 in-.25 in
- Control:
  - Max Load: 318.85 lbf
  - Max Tensile Extension: .26 in
- Average Baseline:
  - Max Load: 335.88 lbf
  - Max Tensile Extension: .41 in

General Notes:

- Varying color with radiated orthofabric; all orthofabric on the same plate (plate 2, round 2) so assuming the plate was consistent with intensity levels, this would not explain the varying color
  - Perhaps actual location on the plate affects how much radiation the sample is receiving
- All samples (including control) failed in a similar manner; not a clean break, more stretched until failure rather than splitting in two (see picture of orthofabric)
- Appeared as though O-18 and O-111 had two radiated areas (one above primary radiated area); potentially due to plate placement, but from plate placement pictures it does not appear it would have been a factor

Max Load Notes:

- Excluding control, range between minimum maximum load and maximum maximum load is relatively small compared to loads observed; max load was the minimum max load values; 42.67 lbf difference between min and max
- Baseline average (335.88 lbf) similar to values obtained with radiated samples
- Radiation did not seem to affect max load values
- O-111 had max max load
- Control had the lowest maximum load (318.85 lbf)

Max Tensile Extension Notes:

- Control had max tensile extension; O-17 (color scale 3) had the minimum tensile extension
- Range of max tensile extensions was small; .04 inches difference; <1% length difference between min and max compared to overall sample length

General Conclusions:

- Radiation does not have a significant effect on Orthofabric
- Max load not significantly affected
- Max tensile extension not significantly affected, but slightly affected

3 oz. Teflon

Assumed Control Sample: T-212

Key Values:

- Max Load Range (Excluding Control): 15.15 lbf-30.90 lbf
- Max Tensile Extension Range (Excluding Control): 1.53 in-2.42 in
- Control:
  - Max Load: 24.38 lbf
  - Max Tensile Extension: 2.76 in
- Average Baseline:
  - Max Load: 30.63 lbf
  - Max Tensile Extension: 3.76 in

General Notes:

- Varying color with radiated Teflon; similar case with orthofabric; all the Teflon is on plate 2 (round 2), so in theory, it should show the same color distortion, but there are varying levels of light/dark on the samples
- All radiated samples failed in a similar manner; clean break; however, the control sample did not completely break like the radiated ones; shows that there may be a connection between radiation and material strength

Max Load Notes:

- Excluding control, max load range was 15.15 lbf-30.9 lbf; control sample fell within this range
- Max load was seen for T-28, which was a 2 on the color scale; also, this value (30.9 lbf) was similar to the average baseline non radiated samples (30.63 lbf)
- Excluding control, max load range relatively large to loads observed; difference between min and max max load was 15.75 lbf

Radiated Materials Tensile Testing: Summary of Results

Material	Mass Difference (g)	Average Max Load Baseline (lbf)	Average Max Load Radiated (lbf)	Average Max Tensile Extension Baseline (in)	Average Max Tensile Extension Radiated (in)
Orthofabric	.0053	335.9	343.4	.410	.238
Teflon	.0053	30.6	24.1	3.76	2.01
Vectran	.0055	464	241	.640	.444
Dacron	.0010	245	105	1.10	.476
Spectra	.0191	1363	1190	14.0	12.0
Bladder Material	.0032	117	100	.85	.50
nGimat Coated Orthofabric	.0061	304	379	1.18	.93
nGimat Coated Teflon	.0006	67.1	51.8	3.32	2.25
Polycarbonate	.0034	1071	1079	.360	.325

Tensile Testing of Radiated Space Suit Materials

Outgassing Testing for SHERLOC on Mars 2020 Rover

Z2 Support

LCVG Flush and Purge Console

Outgassing Testing for SHERLOC on Mars 2020 Rover

- SHERLOC
  - Scanning Habitable Environments with Ramen and Luminescence for Organics and Chemicals
  - Will search for organic materials altered by water environments
- Space suit materials will be placed on the SHERLOC calibration target

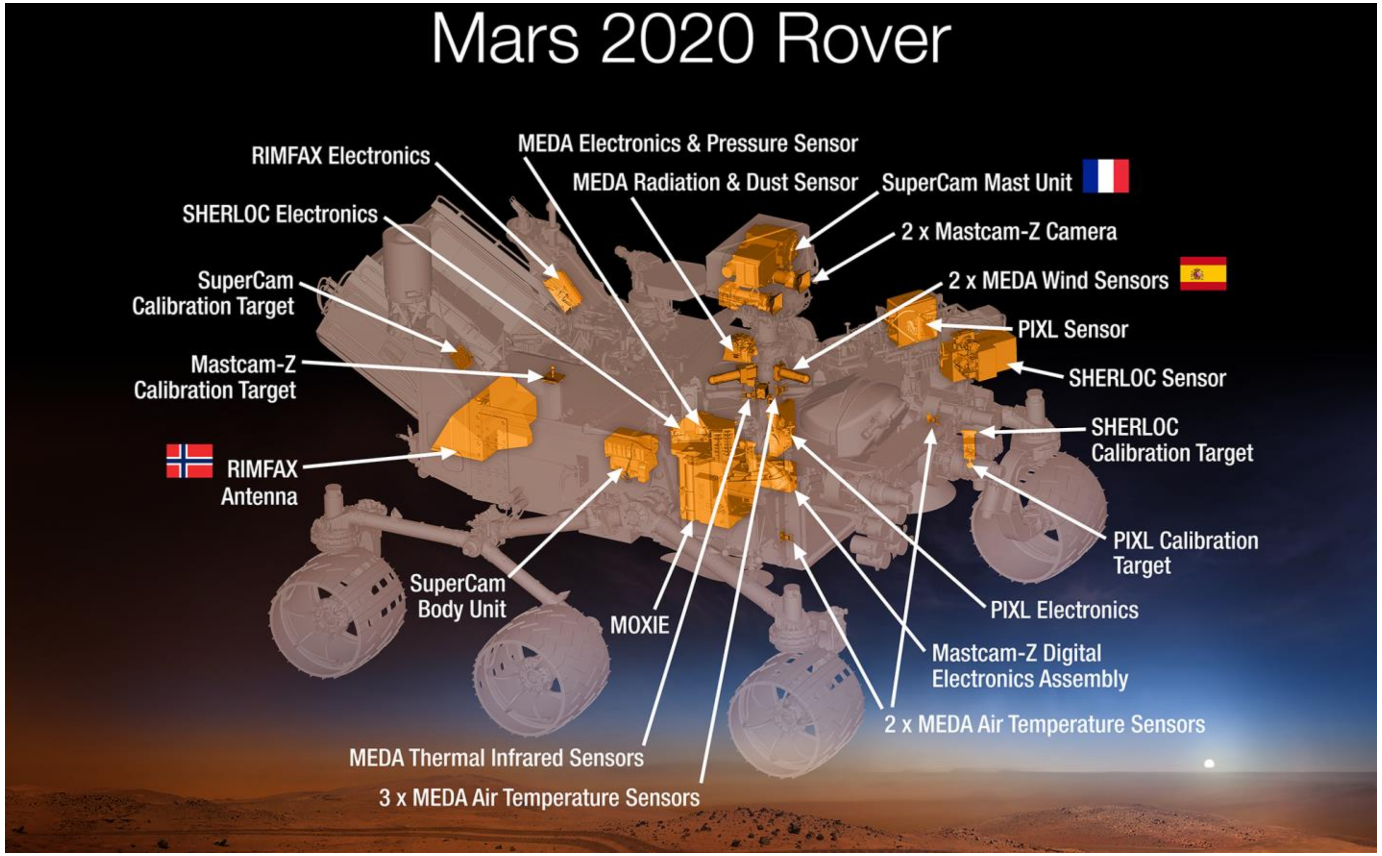
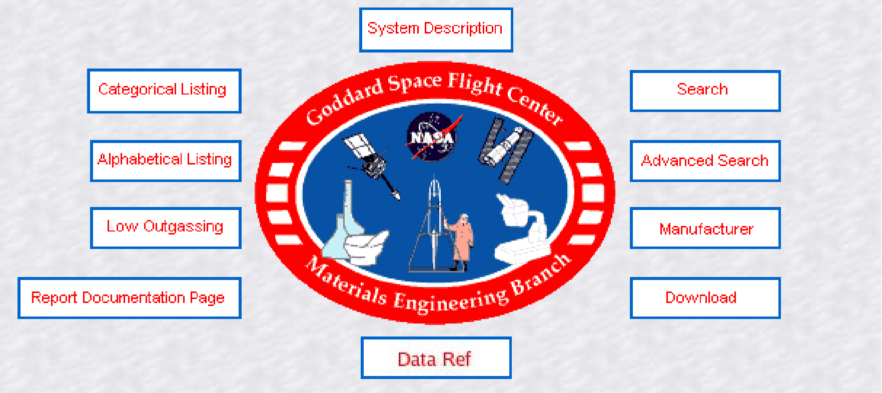
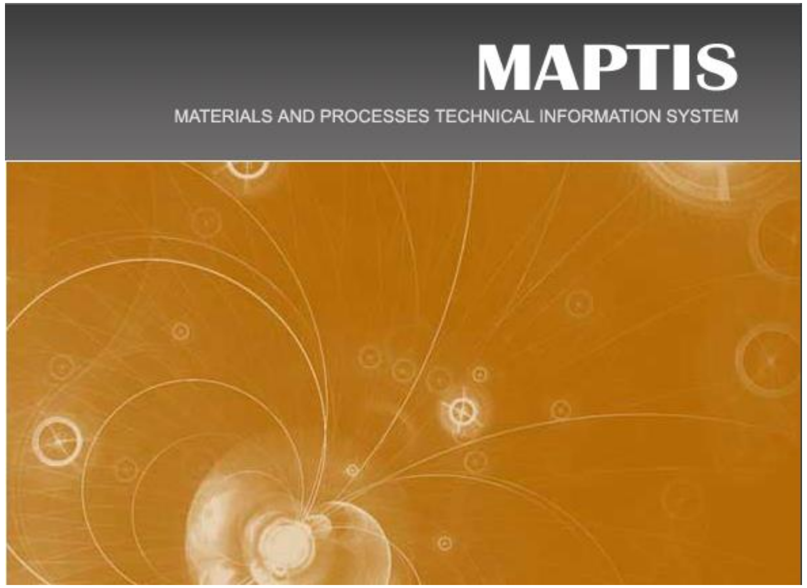


Image credit: NASA

Outgassing Testing for SHERLOC on Mars 2020 Rover

- Became familiar with and understood contents of the Goddard outgassing database
- Put together database summary of relevant materials
- Compared to NASA’s MAPTIS materials database
- Helped to determine additional testing would be required for some samples





Outgassing Testing for SHERLOC on Mars 2020 Rover

- Requirements: Must pass ASTM E595 standards
  - <1.0% Total Mass Loss (TML)
  - <.1% Collected Volatile Condensable Materials (CVCM)

Pass	Fail	Unsure
Orthofabric	Bladder Material (>1.0% TML)	Spectra
Polycarbonate		nGimat Coated Orthofabric
Teflon		nGimat Coated Teflon
Vectran		
Dacron		

Outgassing Testing for SHERLOC on Mars 2020 Rover

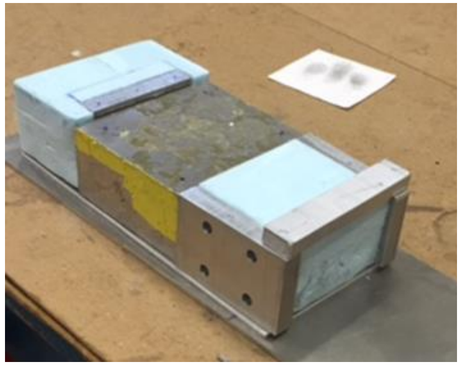
- Requirements: Must pass ASTM E595 standards
  - <1.0% Total Mass Loss (TML)
  - <.1% Collected Volatile Condensable Materials (CVCM)

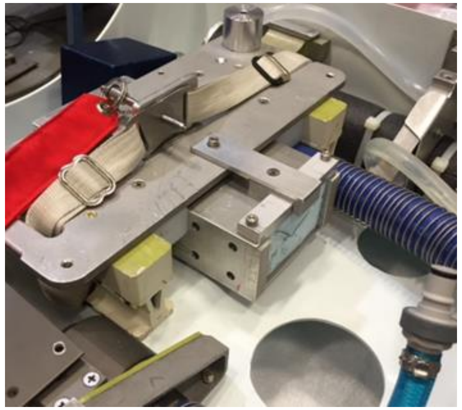
Pass	**Fail**	**Unsure**
Orthofabric	Bladder Material (>1.0% TML)	
Polycarbonate	Spectra (.4% CVCM)	
Teflon	nGimat Coated Orthofabric (1.2% TML)	
Vectran		
Dacron		
nGimat Coated Teflon		

- Tensile Testing of Radiated Space Suit Materials
- Outgassing Testing for SHERLOC on Mars 2020 Rover
- Z2 Support
- LCVG Flush and Purge Console

Z2 Support: Pre Manned NBL Testing

- Assisted with preparing Corn Man
- Made a communication box mockup for the Corn Man test





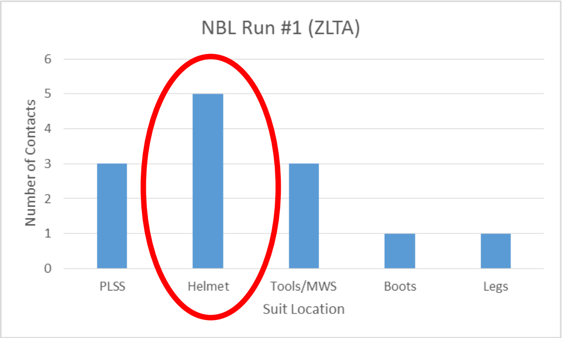
Z2 Support: Pre-NBL Testing

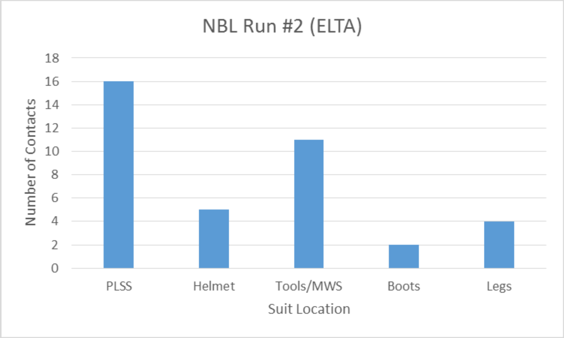
- Assisted with preparing Z2 Processing Procedures
  - DIDB
  - MAG
- Assisted with preparing data scales
- Suit Fit Checks

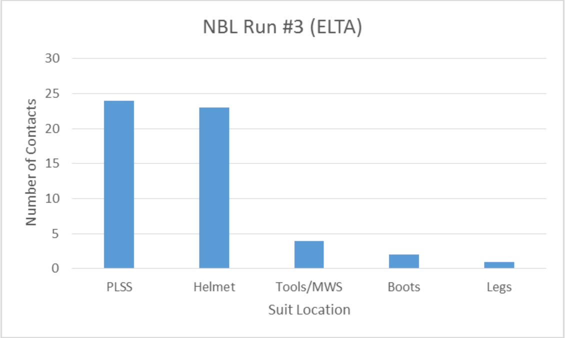
Z2 Support: NBL Testing

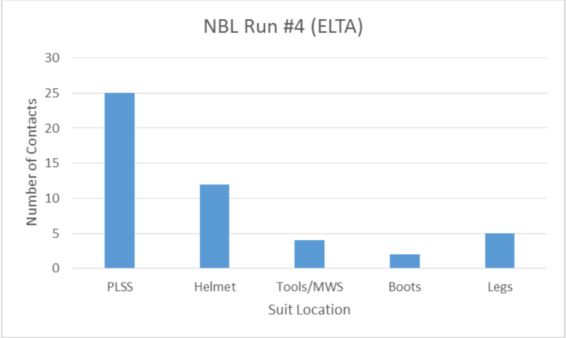
- Weigh outs
  - Assisting as needed with keeping track of weight pack adjustments
- Contact Points
  - Recording contact points during testing
  - Developing standardized system/guidelines
  - Interpreting contact points results
- NBL Data
  - Organizing and combining data into one spreadsheet

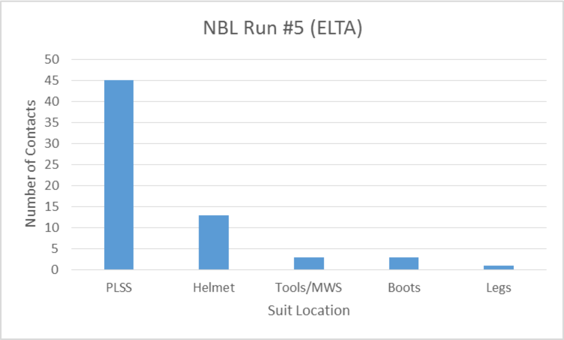
Z2 NBL Support: Contact Points Analysis

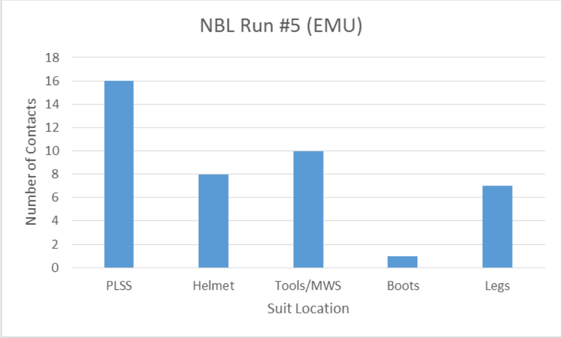


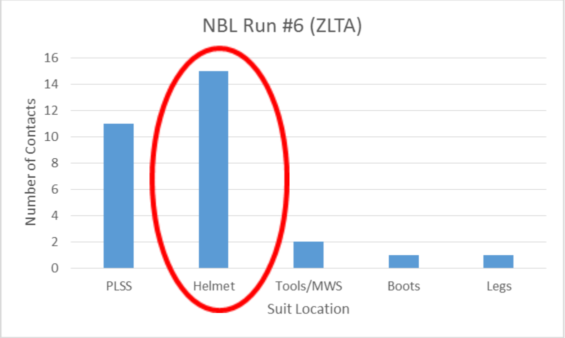


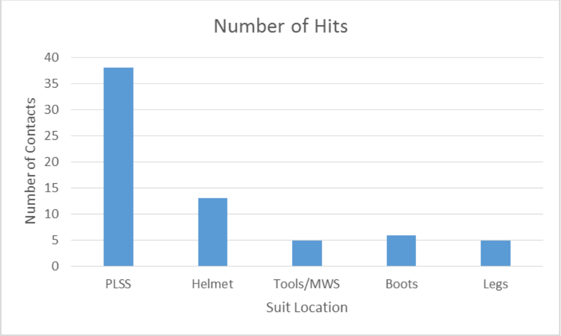












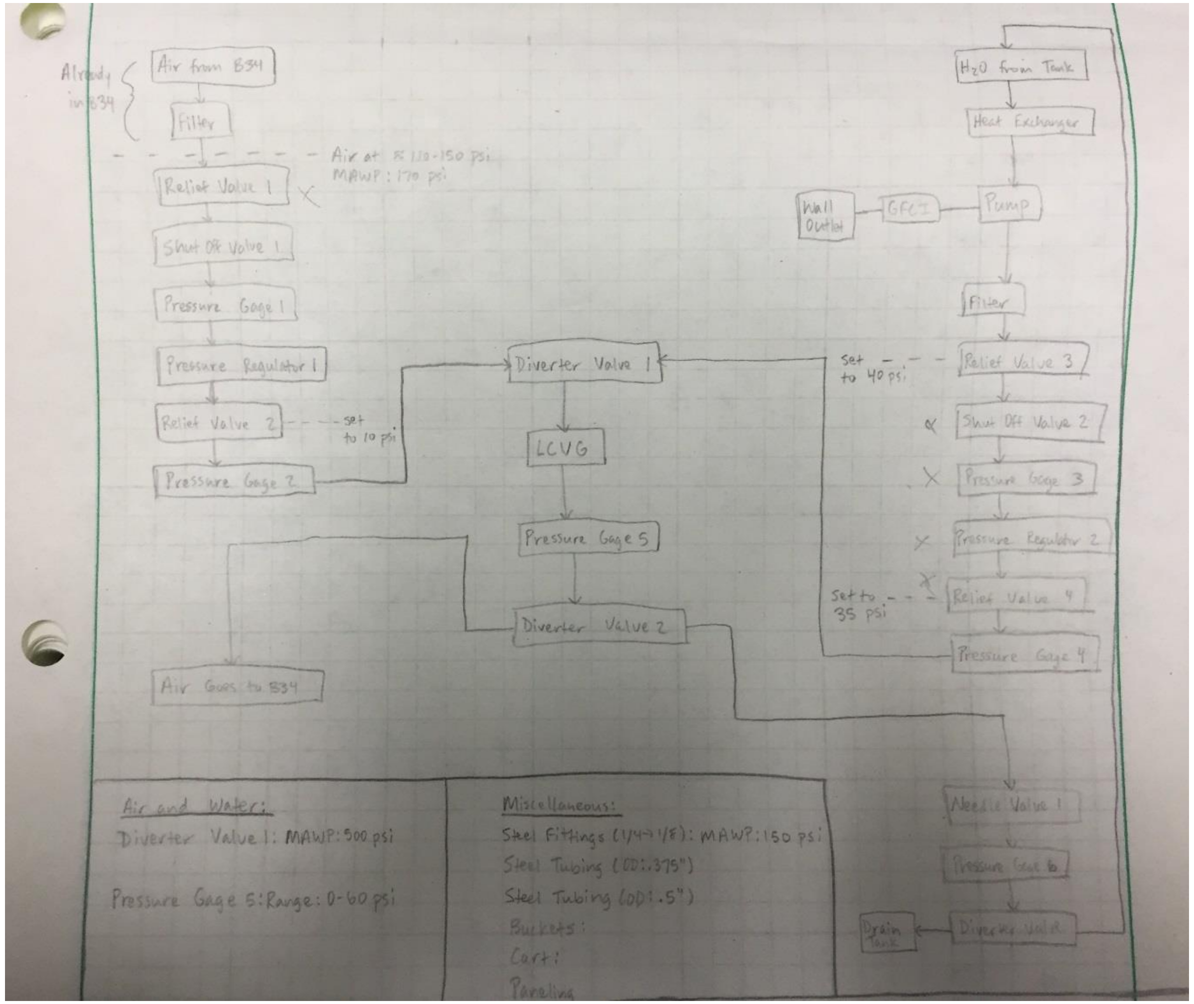
- Tensile Testing of Radiated Space Suit Materials
- Outgassing Testing for SHERLOC on Mars 2020 Rover
- Z2 Support
- LCVG Flush and Purge Console

LCVG Modified Flush and Purge Console

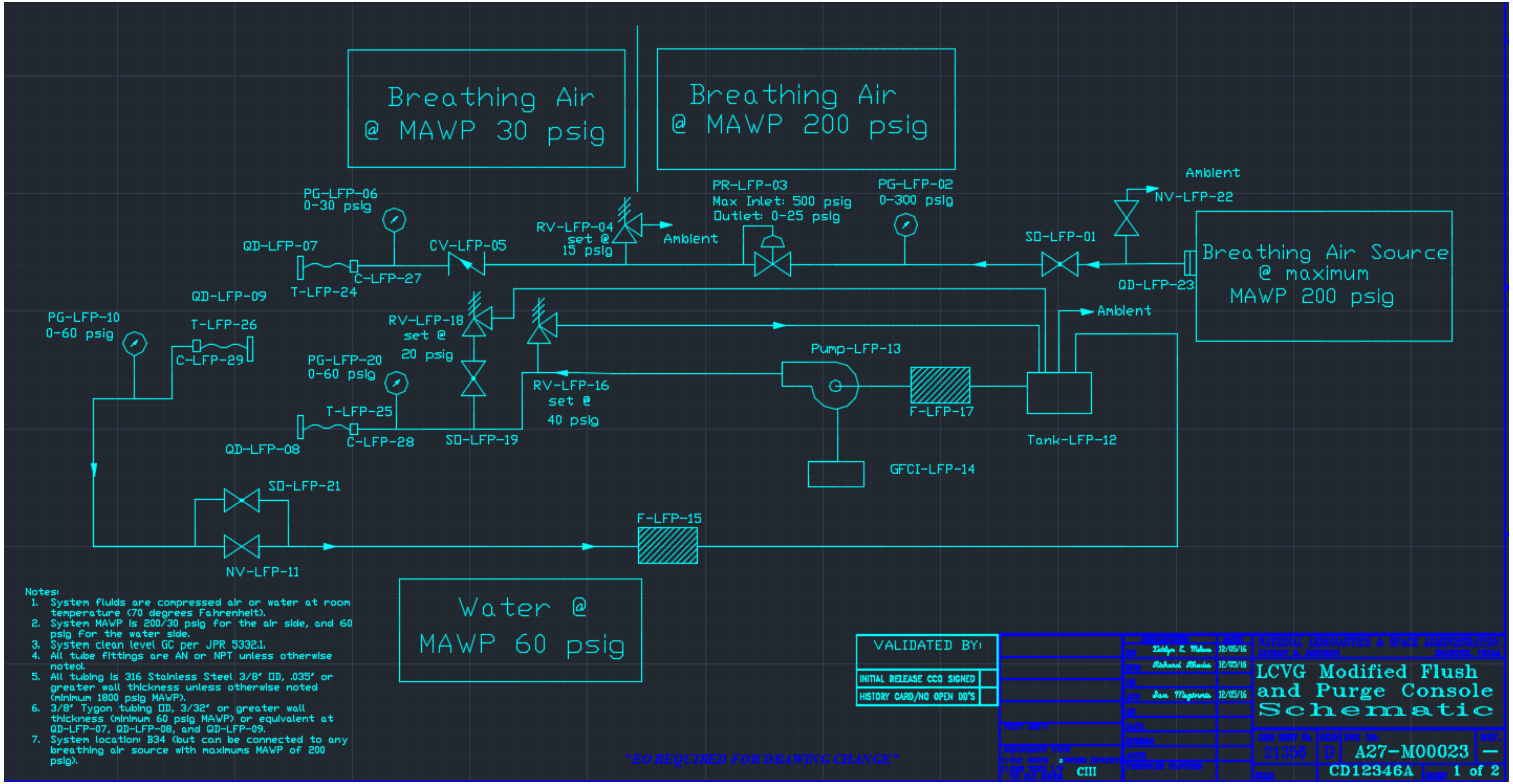
- Objective:
  - Design an LCVG Flush and Purge Console
- Requirements:
  - Must be able to flush and purge the LCVG
  - Must be able to structurally test the LCVG
  - Must have access to both air and water
  - Must be as small as possible
  - ~$2000 budget
- Importance:
  - Ability to test at higher pressures
  - B34 location

LCVG Modified Flush and Purge Console

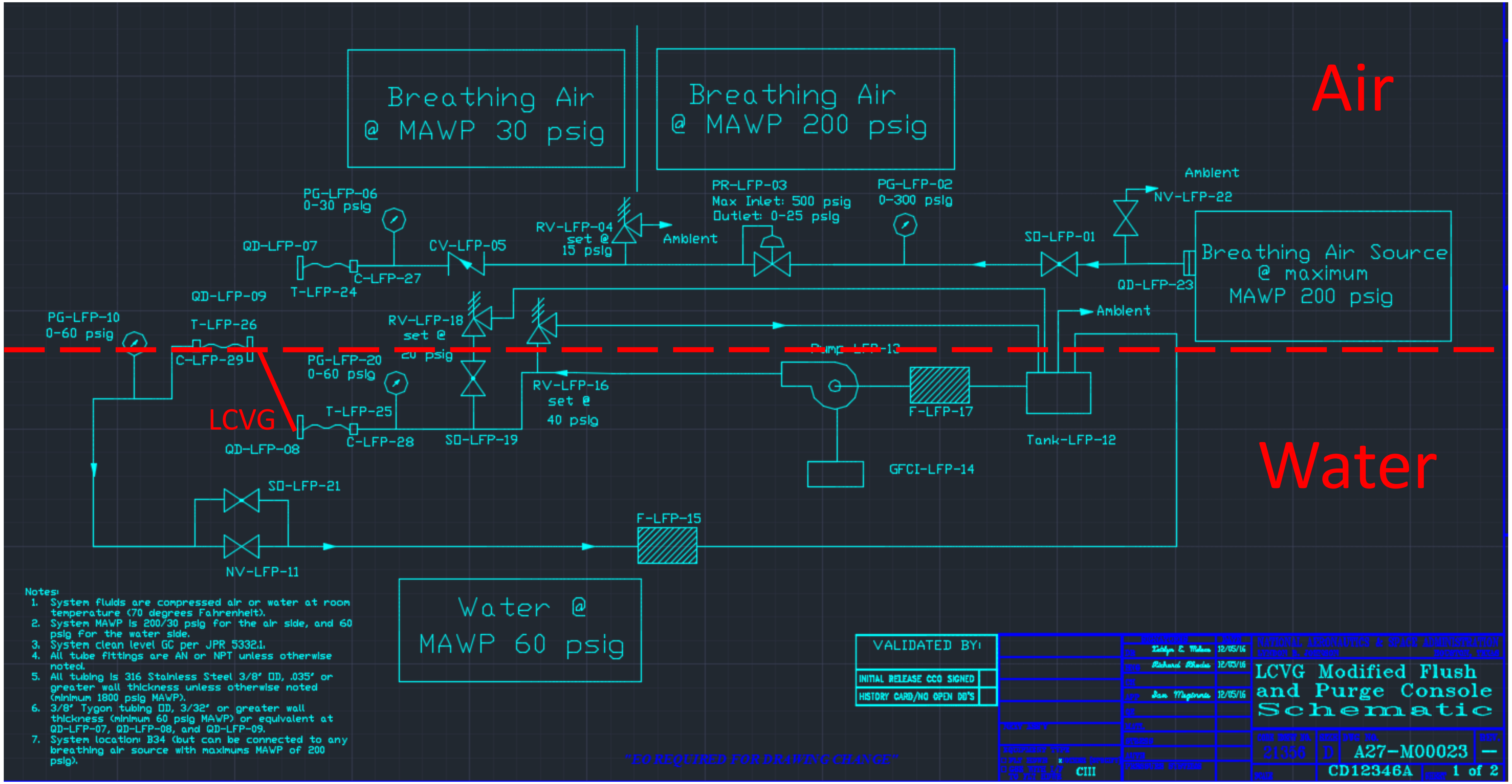
- Preparation
  - Became familiar with pressure system components
  - Pressure Systems Design Course
  - Reference previous LCVG Flush and Purge Console Design



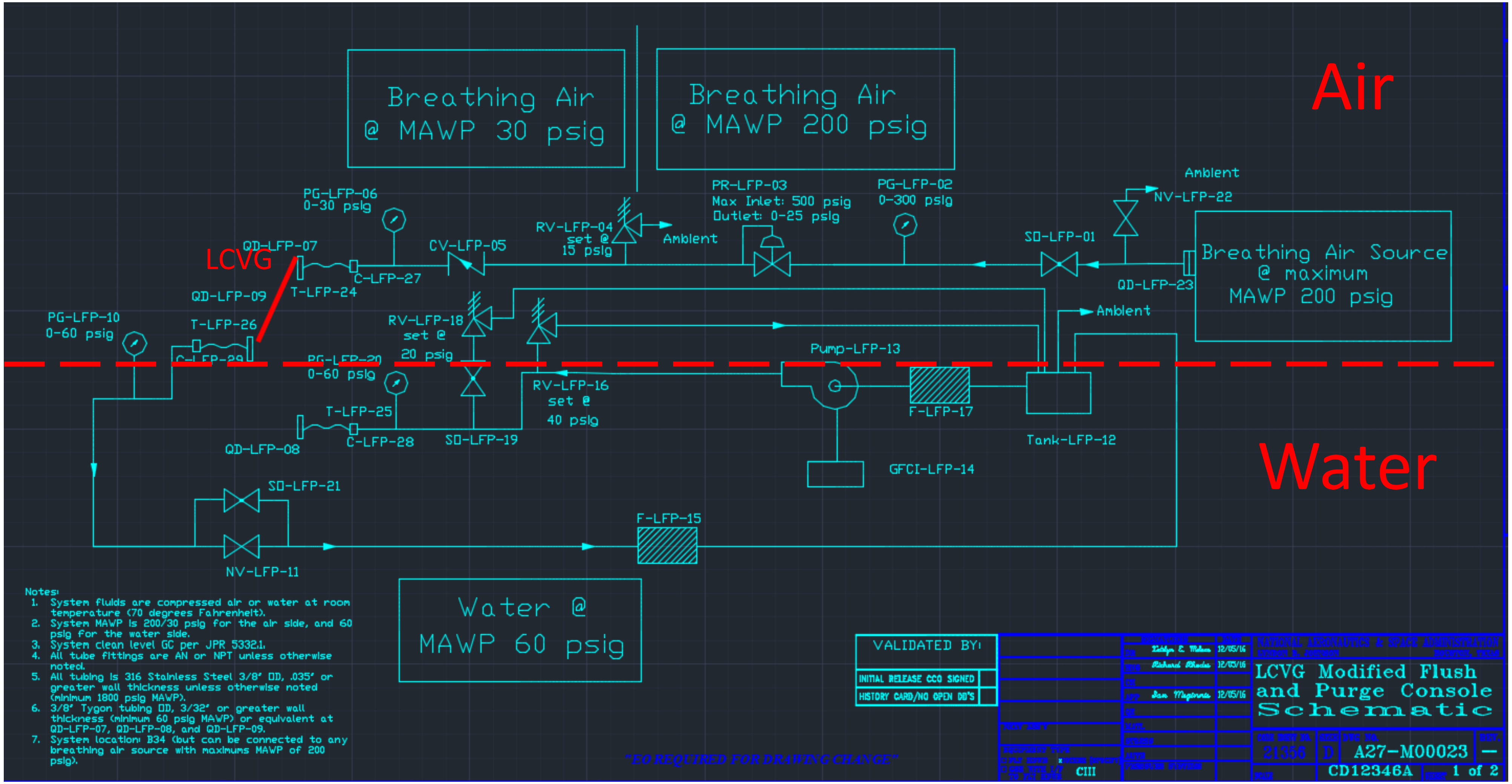
LCVG Modified Flush and Purge Console



LCVG Modified Flush and Purge Console: Structure Test



LCVG Modified Flush and Purge Console: Purging LCVG



LCVG Modified Flush and Purge Console: Approval Process

Reference Designators	Manufacturer	Item	Manufacturer Part #	McMaster Part #	MAWP	Specifications
SO-LFP-01	Anderson Brass Company	Shut Off Valve		3662T24	200 psig @70F	1/4 x 1/4 Pipe Size, Brass
PG-LFP-02	Ashcroft Inc	Pressure Gage (0-300 psig)		4089K63	300 psig	1/4 NPT Pipe, Brass Connection Material
PR-LFP-03	Swagelok	Pressure Regulator (Air)	KLF1DJA411A60000		Inlet: 500 psig, Outlet: 0-25 psig	1/4 x 1/4 Pipe Size, Brass
RV-LFP-04	Circle Seal	Relief Valve (Air)	A-532T1-6M-15	NA	400 psi	3/4 Pipe Size, 316 Stainless Steel, Set at 15 psig
CV-LFP-05	Conbraco Industries	Check Valve		47715K21	400 psig @70F	1/4 x 1/4 Pipe Size, Bronze
PG-LFP-06	Ashcroft Inc	Pressure Gage (0-30 psig)		4089K63	30 psig	1/4 NPT Pipe, Brass Connection Material
QD-LFP-07	Colder Products Company	Male Quick Disconnect; Barbed Valve Couplings	NS4D22006	NA	120 psig	Polypropylene, 3/8 Barb Valved In-Line
QD-LFP-08	Colder Products Company	Male Quick Disconnect; Barbed Valve Couplings	NS4D22006	NA	120 psig	Polypropylene, 3/8 Barb Valved In-Line
QD-LFP-09	Colder Products Company	Male Quick Disconnect; Barbed Valve Couplings	NS4D22006	NA	120 psig	Polypropylene, 3/8 Barb Valved In-Line
PG-LFP-10	Ashcroft Inc	Pressure Gage (0-60 psig)		4089K63	60 psig	1/4 NPT Pipe, Brass Connection Material
NV-LFP-11	Deltrol Fluid Products	Needle Valve		46425K12	2000 psig @ 400F	1/4x1/4 Pipe Size, Brass
Tank-LFP-12	Den Hartog Industries Inc	Tank		4439T11	NA	Polyethylene plastic, max temperature 120F, 5 gallon capacity
Pump-LFP-13	Aquatec	Pump	5851-7E12-J574	NA	Max inlet pressure 60 psig, maximum discharge pressure 70 psig	115 VAC, .7 gpm maximum
GFCI-LFP-14	Tripp-Lite	Surge Protector with GFCI and Switch	TLM609GF	7693K49	NA	Built in GFCI and switch
F-LFP-15	General Electric	Filtration System	GXWH04F	NA	125 psig	3/4" connection, compatible with pleated filter Model #FXWPC from General Electric
RV-LFP-16	Pentair	Relief Valve (Water)		4662K461	600 psig (max set pressure); set at 40 psig	1/4 NPT Pipe, Bronze body, set at 40 psig
F-LFP-17	Swagelok	Filter	SS-6TF-15	NA	1000 psi (min)	connection, 316 Stainless Steel, .213 in orifice, 15 micron pore size
RV-LFP-18	Pentair	Relief Valve (Water)		4662K461	600 psi (max set pressure); set at 20 psig	1/4 NPT Pipe, Bronze body, set at 20 psig
SO-LFP-19	Anderson Brass Company	Shut Off Valve		3662T24	200 psig @70F	1/4 x 1/4 Pipe Size, Brass
PG-LFP-20	Ashcroft Inc	Pressure Gage (0-60 psig)		4089K63	60 psig	1/4 NPT Pipe, Brass Connection Material
SO-LFP-21	Anderson Brass Company	Shut Off Valve		3662T12	200 psig @70F	1/4 x 1/4 Pipe Size, Brass
NV-LFP-22	Deltrol Fluid Products	Needle Valve		46425K12	2000 psig @ 400F	1/4 x 1/4 Pipe Size, Brass
QD-LFP-23	Hansen Products	Male Quick Disconnect; Hydraulic Coupling	Item #41 (Series 4000)	NA	1000 psig	1/4 x 1/4 NPT, Stainless Steel
T-LFP-24	Tygon	Tygon Tubing with Barbed Fittings		6516T53	60 psig @ 72F	PVC Plastic
T-LFP-25	Tygon	Tygon Tubing with Barbed Fittings		6516T53	60 psig @ 72F	PVC Plastic
T-LFP-26	Tygon	Tygon Tubing with Barbed Fittings		6516T53	60 psig @ 72F	PVC Plastic
C-LFP-27	Grainger	Barbed Male Connector	2GUR1	NA	150 psig	Brass, 3/8" OD, .25" Barb Size
C-LFP-28	Grainger	Barbed Male Connector	2GUR1	NA	150 psig	Brass, 3/8" OD, .25" Barb Size
C-LFP-29	Grainger	Barbed Male Connector	2GUR1	NA	150 psig	Brass, 3/8" OD, .25" Barb Size

LCVG Modified Flush and Purge Console: RV Calculation

Pressure Regulator

- $Q = C_v * [\frac{816*P_1}{\sqrt{S.G.*T}}]$
- $Q = .02 * [\frac{816*214.7}{\sqrt{1*530}}]$
- $Q = 153\ SCFH = 2.5\ SCFM$

Relief Valve

M = Popoff valves, ½"–1"; MP = Inline valves, ⅜"–1¼"

Crack Pressure PSIG	Percent Over Pressure Beyond Cracking (SCFM air at room temperature)								
	10%			25%			50%		
	4M/6MP	6M/8MP	8M/10MP	4M/6MP	6M/8MP	8M/10MP	4M/6MP	6M/8MP	8M/10MP
.5	.07	.07	—	.50	.50	—	.80	2.2	—
1	.10	.10	—	.70	.70	—	1.7	3.2	—
1.5	.30	.30	—	1.0	1.4	—	2.2	5.5	—
2	.50	.50	—	1.2	1.7	—	3.0	7.0	—
2.5	.60	.60	—	1.8	3.0	—	4.2	10.5	—
3	.80	.80	—	2.2	4.0	—	5.0	13	—
4	1.0	1.0	1.5	3.0	5.0	30	7.5	17	56
5	1.0	1.2	2.5	3.5	6.0	34	9.0	20	64
10	1.0	2.4	7.0	6.0	12	60	19	40	115
15	1.6	3.0	7.0	8.5	22	60	27	80	160
20	2.0	5.0	7.0	10	30	60	34	110	190
25	3.0	5.5	9.0	13.5	34	72	43	116	—
30	3.5	6.0	11.5	16	37	80	50	121	—
40	5.5	8.5	18	24	48	115	72	136	—
50	7.0	10	23	30	56	140	90	150	—
60	11	13	35	38	64	160	100	165	—
70	15	17	59	47	72	185	111	182	—
80	20	21	77	56	81	215	123	204	—
90	26	26	88	68	94	235	138	225	—
100	30	30	100	75	105	250	150	240	—
110	33	38	115	80	112	258	166	—	—
120	37	47	132	86	125	270	183	—	—
130	41	57	150	93	150	282	201	—	—
140	46	71	175	102	163	290	222	—	—
150	50	80	190	110	175	300	240	—	—

LCVG Modified Flush and Purge Console: Approval Process

National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas 77058

PRESSURE SYSTEM DESIGN REVIEW RECORD

Design Review Number
DATE:

INITIATOR: Kate Melone
ORGANIZATION: EC5
PHONE NO.: 302-650-2769

SYSTEM ☒ VESSEL ☐ OTHER: ☐

SYSTEM / VESSEL NUMBER: A2700023
SYSTEM / VESSEL NAME: Liquid Cooling Ventilation Garment (LCVG) Modified Flush and Purge Console
System Location: Site: JSC Building: 34 Room: 109
MAWP: Air: 200 psig, 30 psig; Water: 60 psig AT: 70 Degrees F
FLUID: Air, Water
OTHER:

System Design Complies with:
- ☒ ASME B31.3 Process Piping Code
- ☐ ASME B31.1 Power Piping Code
- ☐ 49 CFR Parts 100-185 (DOT)
- ☐ Other
- ☐ ASME B&PVC Sect. VIII Div. 1
- ☐ ASME B&PVC Sect. I
- ☐ ASME B&PVC Sect. IV

DRAWING NUMBER: A27-M00023 (Sheets 1 and 2) REVISION: Basic
PSE APPROVAL:
DATE:
CALCULATIONS:
PSE APPROVAL:
DATE:

COMMENTS
LCVG connects between T-LFP-18 and T-LFP-25 for purging the LCVG with air. LCVG connects between T-LFP-19 and T-LFP-25 for flushing the LCVG with water. The LCVG Modified Flush and Purge Console connects to the PGA test stand in B34 (system number L1601003) for the breathing air source.

JSC Form 1876 (Rev August 29, 2013) (MS Word Aug 98)

1876 Form

JSC Pressure System
System Inventory Input/Change Form
Page: 1 of 2

INPUT: ☒ Add New ☐ Other: ☐ Change Status to: (select as needed)

Current information on existing items is available from http://sma.jsc.nasa.gov/psdb/pressure.aspx

GENERAL INFORMATION: Status: Active Category: A
Responsible Org.: EC5 System Number: **A2700023**
Coordinator: John Harris
System Description: Liquid Cooling Ventilation Garment (LCVG) Modified Flush and Purge Console
System Location: Site: JSC Building: 34 Room: 109
Further Directions:
Service Fluid(s): Air, Water OCCP#:
MAWP:
Drawing No.: A27-M00023 Rev: Basic Design Review Date:
Tube Trailer: No Manufacture Date:
PSCR: Waiver:

Relevant Damage Mechanisms:
- ☐ Corrosion (Atmospheric, Under Insulation, Soil, Galvanic, etc.)
- ☐ Erosion
- ☐ Fatigue (Vibration/Pressure or Thermal Cycling)
- ☐ Creep
- ☐ Refractory Degradation

Inspection Type:	Frequency:	Inspector's Stamp:		Date:
CLASS 1	**730** days.	Pass	Fail	

COMMENTS:
MAWP for Air: 200 psig, 30 psig
MAWP for Water: 60 psig

Component Number	P/Serial Number	Comp Type	MAWP or Marked Set Pressure	Size	Manufacturer Name	and Date	Inspection Type	Due Date	Status
RV-LFP-04		RV	15.00	3/4 x 3/4	Circle Seal				
				x					
				x					
				x					
				x					
				x					

JSC Form 366S (Rev August 29, 2013) (MS Word March 2005)

366S Form

JSC Pressure System
Component Inventory Input/Change Form
Page: 1 of 1

INPUT: ☒ Add New Component ☐ Remove Existing Component from System ☐ Other: ☐ Change Status to: (select as needed)

Current information on existing items is available from http://sma.jsc.nasa.gov/psdb/pressure.aspx

Component Type: ☒ Relief Valve ☐ Rupture Disk ☐ Flex Hose ☐ Vessel ☐ Other -

GENERAL INFORMATION: Status: Active Category: A
Responsible Org.: EC5 System Number: **A2700023**
Coordinator: John Harris
System Description: Liquid Cooling Ventilation Garment (LCVG) Modified Flush and Purge Console
Component Number: **RV-LFP-04** P/Serial Number:
System Location: Site: JSC Building: 34 Room: 109
Further Directions:
Size: (for RV – In & Out for FH & V – Dia & Len) 3/4 x 3/4 units Service Fluid: Air
Applicable Code: none Flow Capacity (RV): 3 SCFM
Component MAWP (FH, V): Set Pressure (RV): 15.00
Manufacturer: Material: 316 Stainless Steel
Manufacturer Date: Rebuild Date:
PSCR: Waiver:

Relevant Damage Mechanisms:
- ☐ Corrosion (Atmospheric, Galvanic, Boiler Water Condensate, Microbiologically Induced, Caustic, Stress Corrosion Cracking, etc.)
- ☐ Erosion
- ☐ Fatigue (Vibration/Pressure or Thermal Cycling)
- ☐ Creep
- ☐ Refractory Degradation

☐ **Inspection / Test:** Clean Level:
Set Pressure Test Value (RV): Test Fluid:
TPS#: Procedure Number:

Inspection Type:	Frequency:	Inspector's Stamp:		Date:
CLASS 1	**730** days.	Pass	Fail	

COMMENTS:

JSC Form 366C (Rev August 29, 2013) (MS Word March 2005)

366C Form

CTSD-ADV-1399
Revision: Basic

Hazard Analysis for the Liquid Cooling Ventilation Garment (LCVG) Modified Flush and Purge Console

Crew and Thermal Systems Division
Systems Test Branch

November 21, 2016
Revision: Basic

Verify this is the correct version before use.

Crew and Thermal Systems Division
Engineering Directorate
Lyndon B. Johnson Space Center
Houston, Texas

Hazard Analysis

LCVG Modified Flush and Purge Console: Status

- [x] Preliminary Research/Preparation
- [x] Design Sketches
- [x] Technical Drawing
- [x] Bill of Materials/ Determining Components (Calculations)
- [x] Required Forms (1876, 366S, 366C)
- [x] Hazard Analysis
- [x] Pressure Systems Approval
- [ ] Order Components and Assemble
- [ ] Test/Inspect/Final Approval

Lessons Learned

- Data can be confusing at times
  - Example: Material appeared to be stronger after radiation
- A lot goes into the formal design process
  - Design review, forms, Hazard Analysis, inspection, etc.
- Understanding specifications
  - AN vs NPT
  - Tube vs Pipe
- Learning about pressure system components
  - In addition to pressure ratings, need to consider size and flow rates

Skills Acquired

- Tensile Testing
  - Prepare materials and setting up the tensile tests
  - Collect and interpret (messy) data
- Outgassing Testing
  - Understand TML and CVCM
  - Collaboration with other NASA centers
- Z2 Support
  - Hands on building mockups of components
  - Analyze data
  - Work with others; understanding what both parties need in order to make a run successful
- LCVG Flush and Purge Console
  - Both formal design and design review process
  - How to determine which components to use; flow calculations, pressure ratings, size, etc.
  - Hazard Analysis
  - How to make design tradeoffs

Future Plans

2017

- Spring: UMD
- Summer: CM4 Co-op
- Fall: UMD

2018

- Spring-Summer: Co-op
- August: Class and Graduate with B.S. in Aerospace Engineering
- Fall: UMD for M.S. in Aerospace Engineering

2019

- Spring: UMD for M.S. in Aerospace Engineering
- Summer: UMD and finish M.S. in Aerospace Engineering
- Fall: Grad co-op/Starting Ph.D.

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- All the co-ops and interns in EC5 (Chad, Kelly, Sarosh)

Questions?